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Overview of US Navy UAS Programs of Record
to
TTCP, MAD UAS Meeting

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July 2012

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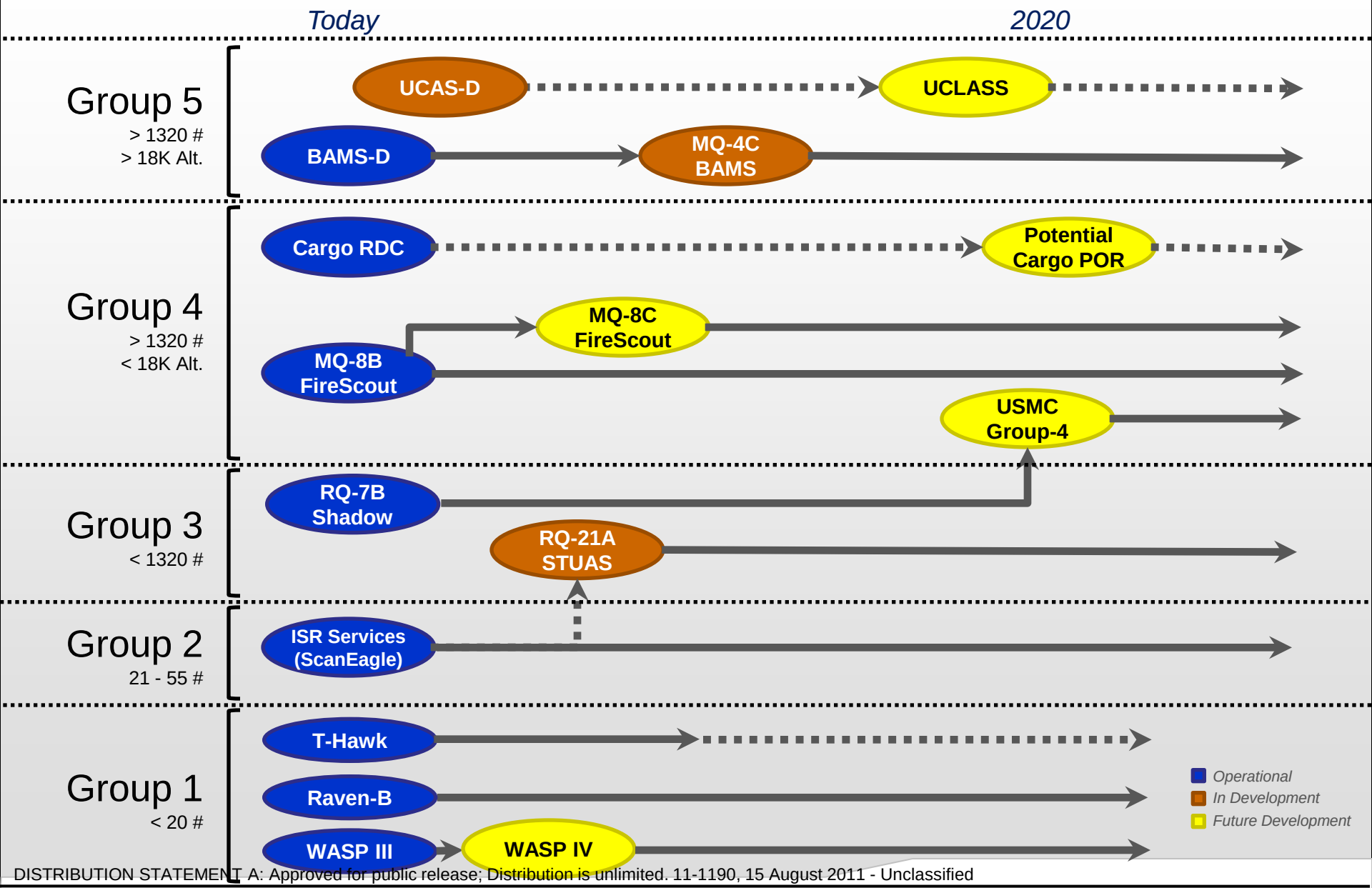
PEO U&W

Naval UAS Family of Systems



UAS Common Control System (CCS)

PMA-281

PEO (U&W) CCS Efficiencies

- **PEO (U&W) has established a Common Control System (CCS) IPT within PMA-281 to address control system commonality across the portfolio of NAVAIR unmanned systems**
- **The CCS IPT is :**
  - Providing the Common Control System framework/common applications for UCLASS and MRMUAS
  - Working common UAS Control System (CS) requirements database across current systems through extensive multi-program reviews
  - Developing the overarching Control System Performance Specification - directly mapped to UCS Architecture
  - Complying with the OSD UCS Architecture as a stated baseline requirement
  - Engaging in OSD UCS Working Group (WG) and developing comprehensive support strategy across the PEO(U&W) UAS programs
  - Executing risk reduction activities to establish the Commercial Off the Shelf (COTS) framework requirements for CCS - incorporation of UCS developed prototype services

UAS CCS Opportunity

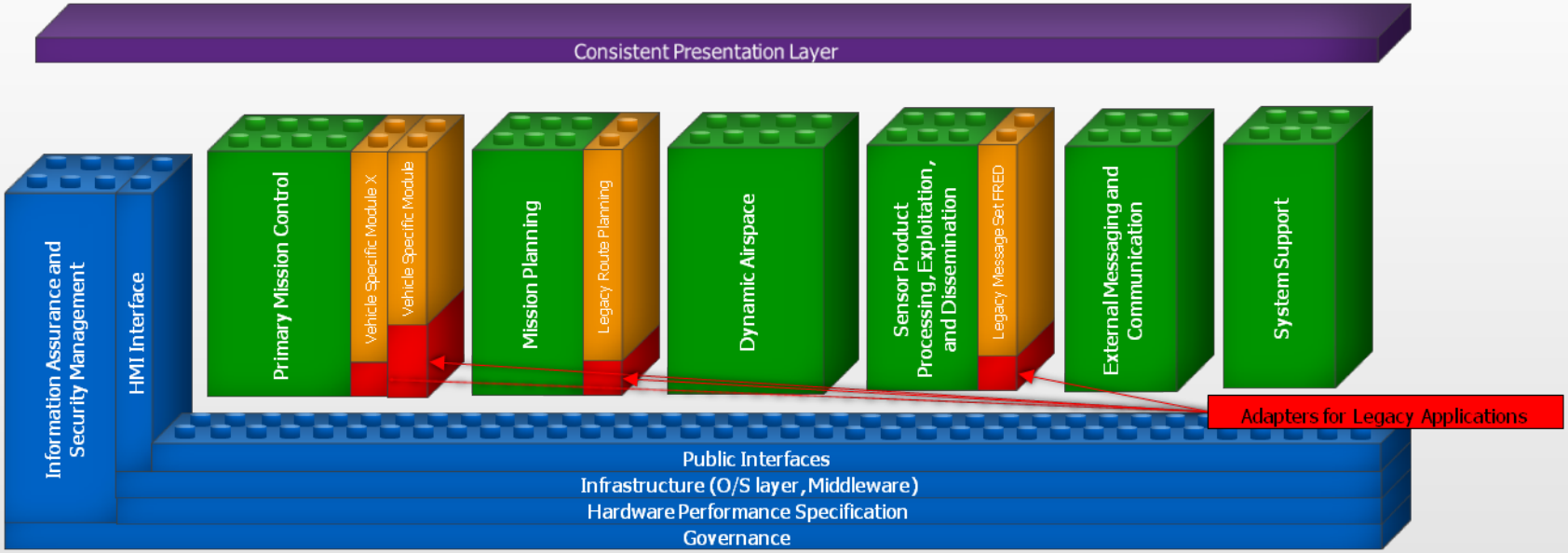
- **Problem: Today's stove-piped unmanned systems programs have redundant GCS cost expenditures & commonality / interoperability limitations**
  - Platform development trades capability of components for the good of the total platform
  - Prime contractor retains control of proprietary solutions
- **Solution: Common Control System for reduced Total Ownership Costs (TOC) and extensive commonality/interoperability capabilities**
  - Development / integration / maintenance / sustainment of software code
  - Rapid integration of new capabilities across the Family of Systems
  - Interoperability
  - Manpower reductions
    - Consistent (Common/Tailorable) User Interface
    - Training
  - Testing
  - Reduce redundant hardware footprint

79% Requirements Commonality Among Navy UAS!

Commonality Brings Significant Cost Avoidance

CCS APPROACH

The CONSISTENT UI (PRESENTATION LAYER) –
Built through Human Computer Interface (HCI) Style Guide and common task execution, maximizes benefits in training, allows for synergy in usability initiatives, reduces development costs



The FRAMEWORK –
Maximize Commercial Off The Shelf (COTS) and H/W independence, minimize size, leverage JMPS model for Bus./Tech. Rules. Must include Information Assurance Boundary

The UNIQUE Applications/Services –
Program of Record (POR) requirements unique to an individual platform, POR responsible for development, CCS responsible for specifications to work in FRAMEWORK and support consistent presentation layer

The COMMON Applications/Services –
Services or Applications that are shared/reused by Unmanned vehicles (UxV's), CCS responsible for specifications to work in FRAMEWORK and support consistent presentation layer

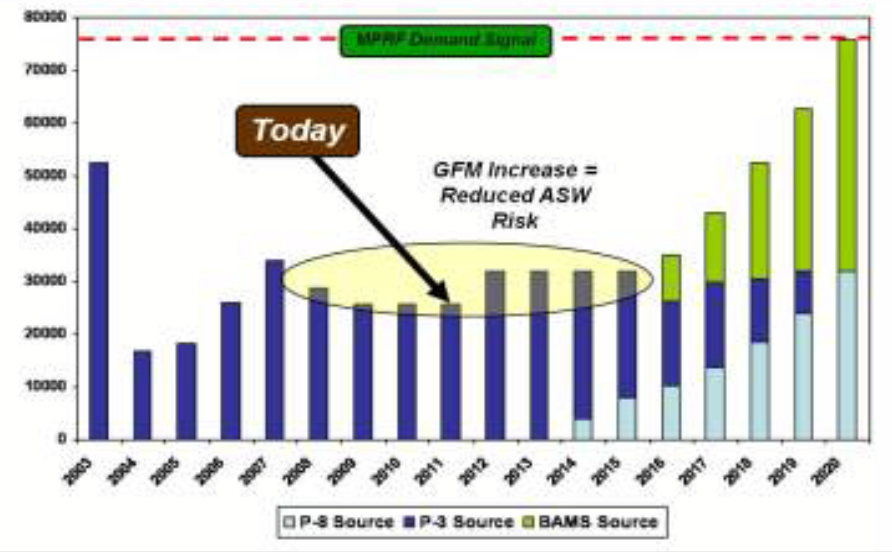
CCS Effort

- **Software**
  - **OSD UAS Control Segment (UCS) Architecture compliant**
  - **COTS-based Framework (O/S, Middleware, Minimum Hardware Specification)**
    - Well-defined Business and Technical Rules
  - Provides interfaces to external services via direct or GIG connection for data consumption and publishing for data consumed and published
  - Consistent (Common/Tailorable) User Interface to maximize operator efficiency & optimize training
  - Scalable with common and unique services
- **Capable of operating all UAV aircraft, such as: BAMS, VTUAV, STUAS, UCLASS, MRMUAS**
  - Designed in an evolutionary open architecture to be compatible with all current and future Navy UxS
- **Leverages existing infrastructure (where possible)**
  - CVNs: Consolidated Afloat Networks and Enterprise Service (CANES) / Afloat Core Services (ACS)
  - Maritime Patrol & Reconnaissance Force (MPRF), Main Operating Bases (MOBs) & Forward Operating Bases (FOBs)

A CCS Comprising Common and Unique Services,
Consistent User Interface Tailored For Each Supported Platform

BAMS

MQ-4C Program of Record

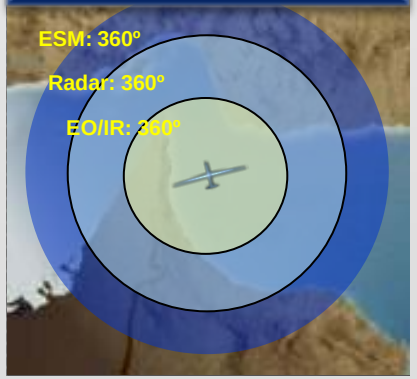


- **"The MQ-4C BAMS, will complement the Navy's fleet of P-8A Poseidon aircraft, to conduct intelligence, surveillance and reconnaissance missions."**

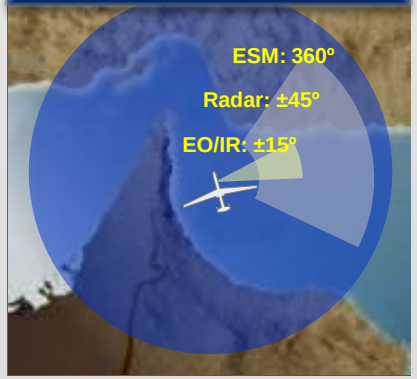
  Admiral Roughead, May 2011

- **Maritime Patrol & Reconnaissance Force (MPRF) community**
  - P-8A Poseidon Adjunct
  - Leverages Pilot, TACCO, and AWO expertise
- **Persistent maritime Intelligence, Surveillance and Reconnaissance (ISR) UAS**
  - Provides a persistent maritime Common Operational Picture
    - Surface Warfare (SUW) during Major Combat Operations
    - "Trip Wire" – Intelligence Preparation of the Environment
    - Homeland Defense / Overseas Contingency Operations

MQ-4C BAMS
SAR / ISAR / Maritime Search (360º)
EO/IR: FMV (360º)
ESM: SEI plus AIS (360º)
Limited Communications Relay
Full Range of Operations

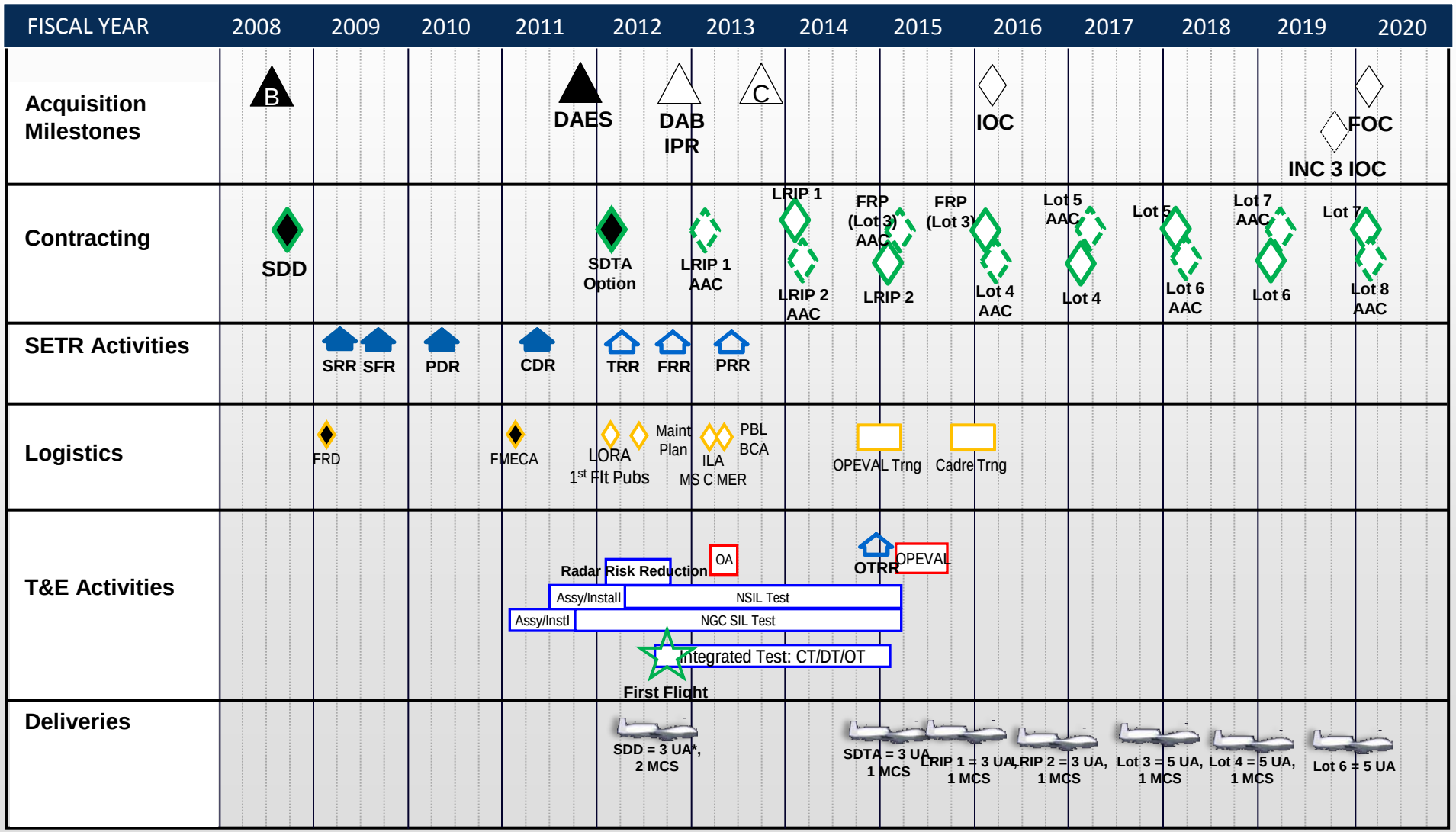


BAMS-D
SAR / ISAR / Maritime Search (±45º)
EO/IR: Still Image (±15º)
ESM: plus AIS (360º)
Single Side Operations – Straight and Level Only



Integrated Maritime Patrol Concept

MQ-4C Program Schedule



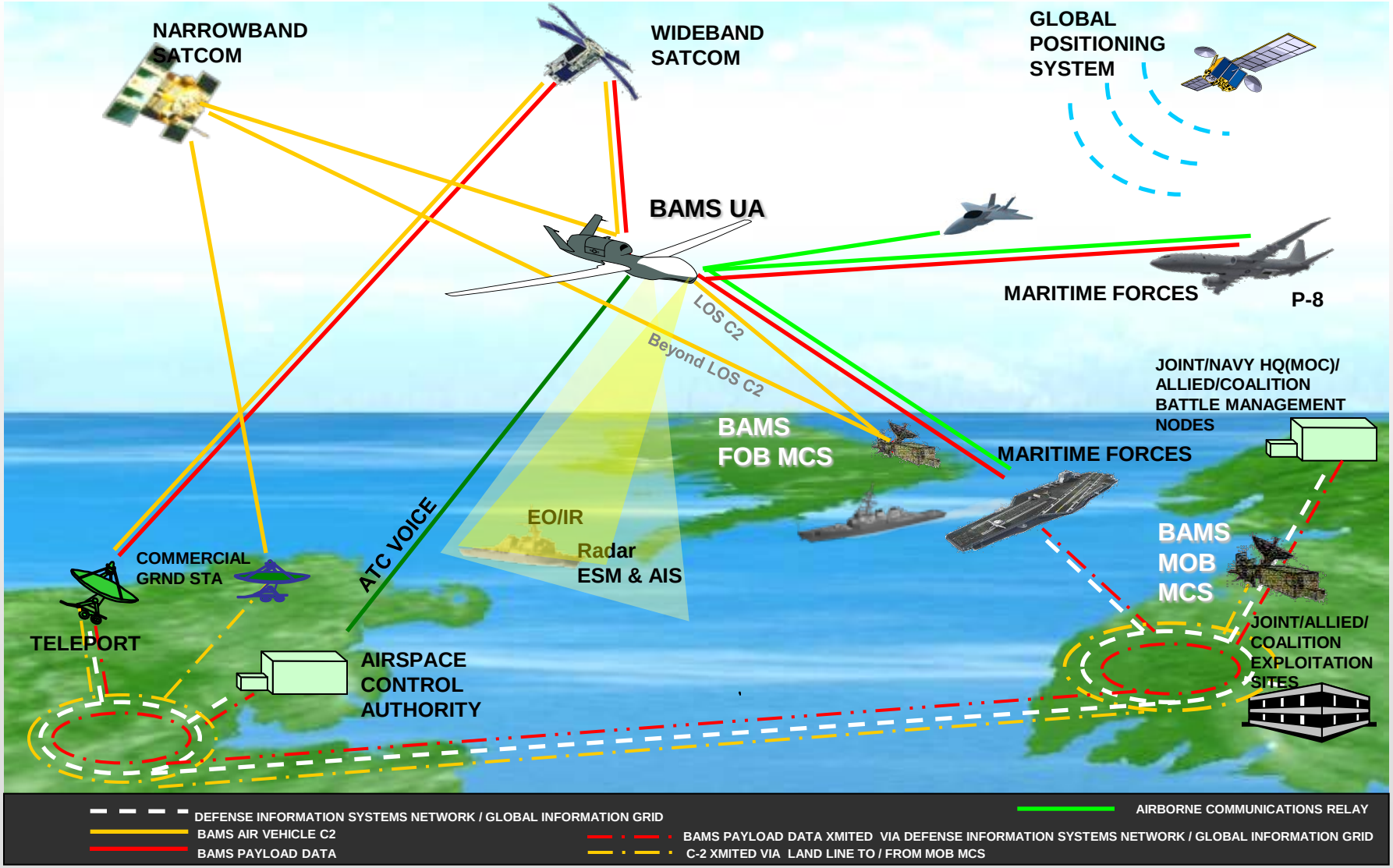
Program Status

- Meeting all Acquisition Program Baseline (APB) parameters
- Conducted first Multi-Function Active Sensor (MFAS) radar G-II risk mitigation flight on December 16, 2011
- SDD-1 and SDD-2 completing assembly at Palmdale, CA
- First flight summer 2012
- On track to achieve IOC in 2015

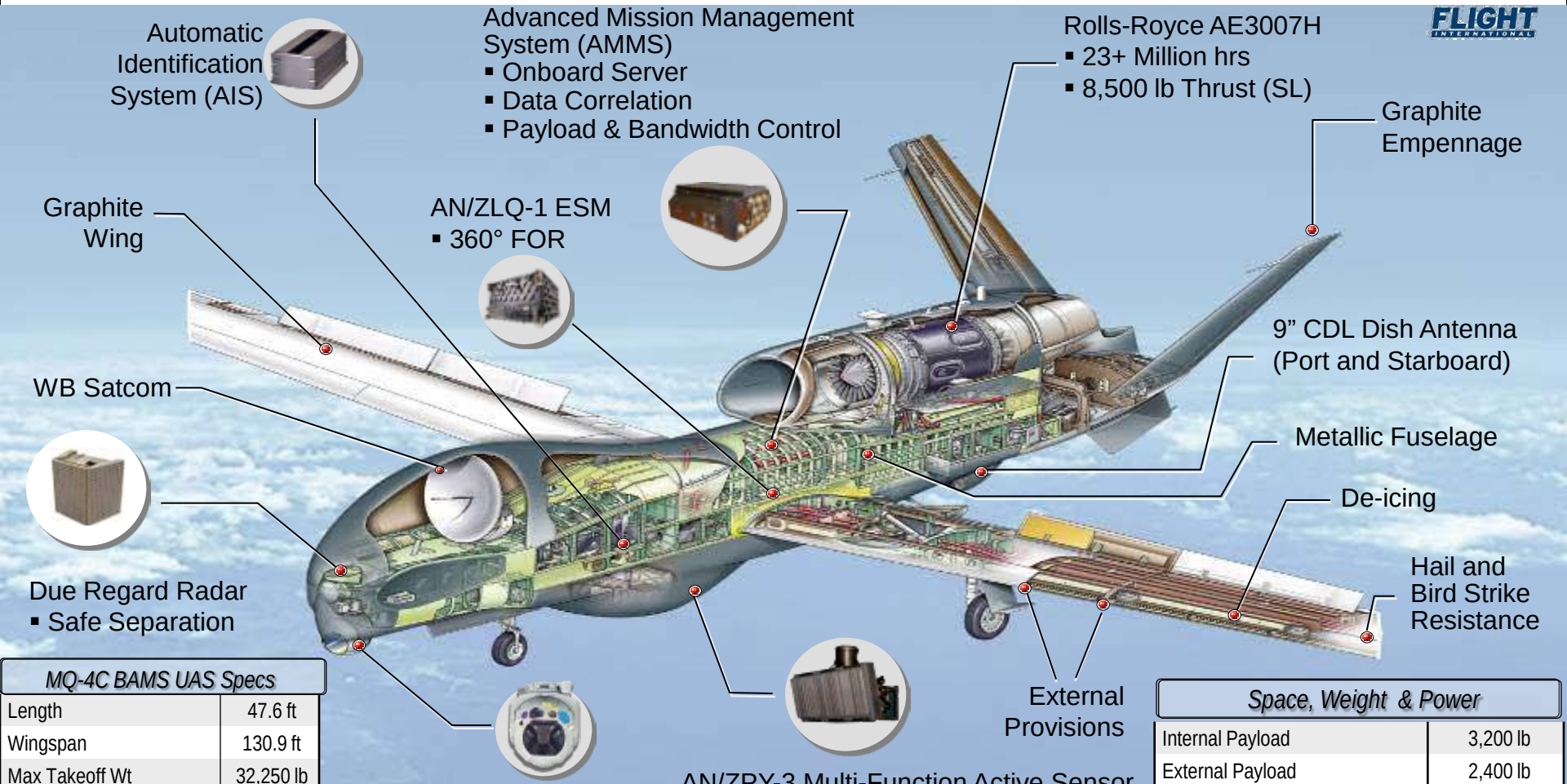
SDD-1 with wings mated

GII First MFAS Flight

Operational Concept



MQ-4C Air Vehicle Configuration



MQ-4C BAMS UAS Specs	
Length	47.6 ft
Wingspan	130.9 ft
Max Takeoff Wt	32,250 lb
Cruise Speed (KTAS)	330 knots
GTOW Rate of Climb (SL)	2,800 fpm
Operational Ceiling	60,000 ft
Max Un-refueled Range	>9,550 nm
Endurance	>24 hr

Space, Weight & Power	
Internal Payload	3,200 lb
External Payload	2,400 lb
Power AC	30.0 kVA
Power DC	400 A
Pressurized Space	180 cu ft
Unpressurized Space	45 cu ft
External Unpressurized Space	132 cu ft
Backup Battery Power	45 min

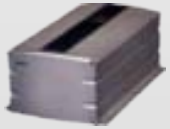
Sensors

Sensors Common Across DoD With Inherent 360º Field of Regard

MFAS

AN/DAS-3

AN/ZLQ-1



Sperry Marine R4

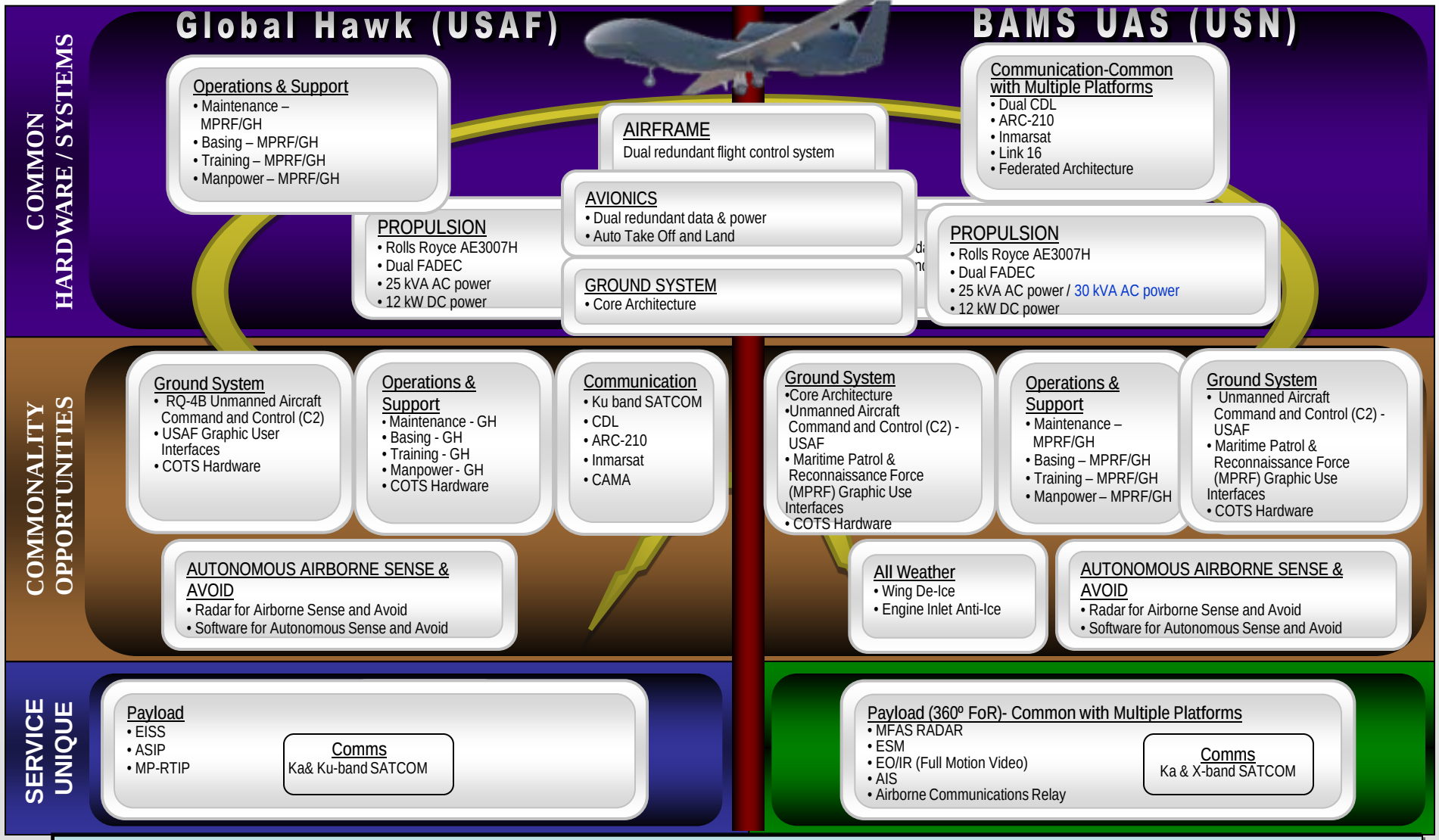
ARC-210/MIDS Link-16

- **Radar**
  - **Multi-Function Active Sensor (MFAS)**
    - » **Maritime Search, ISAR, SAR**
    - » **AESA design and numerous subcomponents leveraged from other systems/platforms**
- **EO/IR**
  - **AN/DAS-3 (MTS-B variant)**
    - » **EO/IR/Full Motion Video**
    - » **Fielded on Air Force system**
    - » **Variant of AN/AAS-52 fielded on other systems/platforms**
- **ESM**
  - **AN/ZLQ-1**
    - » **Technology used on other systems/platforms**
- **AIS**
  - **Sperry Marine R4**
    - » **COTS**
- **Airborne Communications Relay**
  - **ARC-210 radios & MIDS Link-16 fielded on multiple platforms**

MQ-4C BAMS UAS MCS Design

*Provisions will be made for 3rd Instructor Operator Station.

GH/BAMS UAS Commonality Current Plan

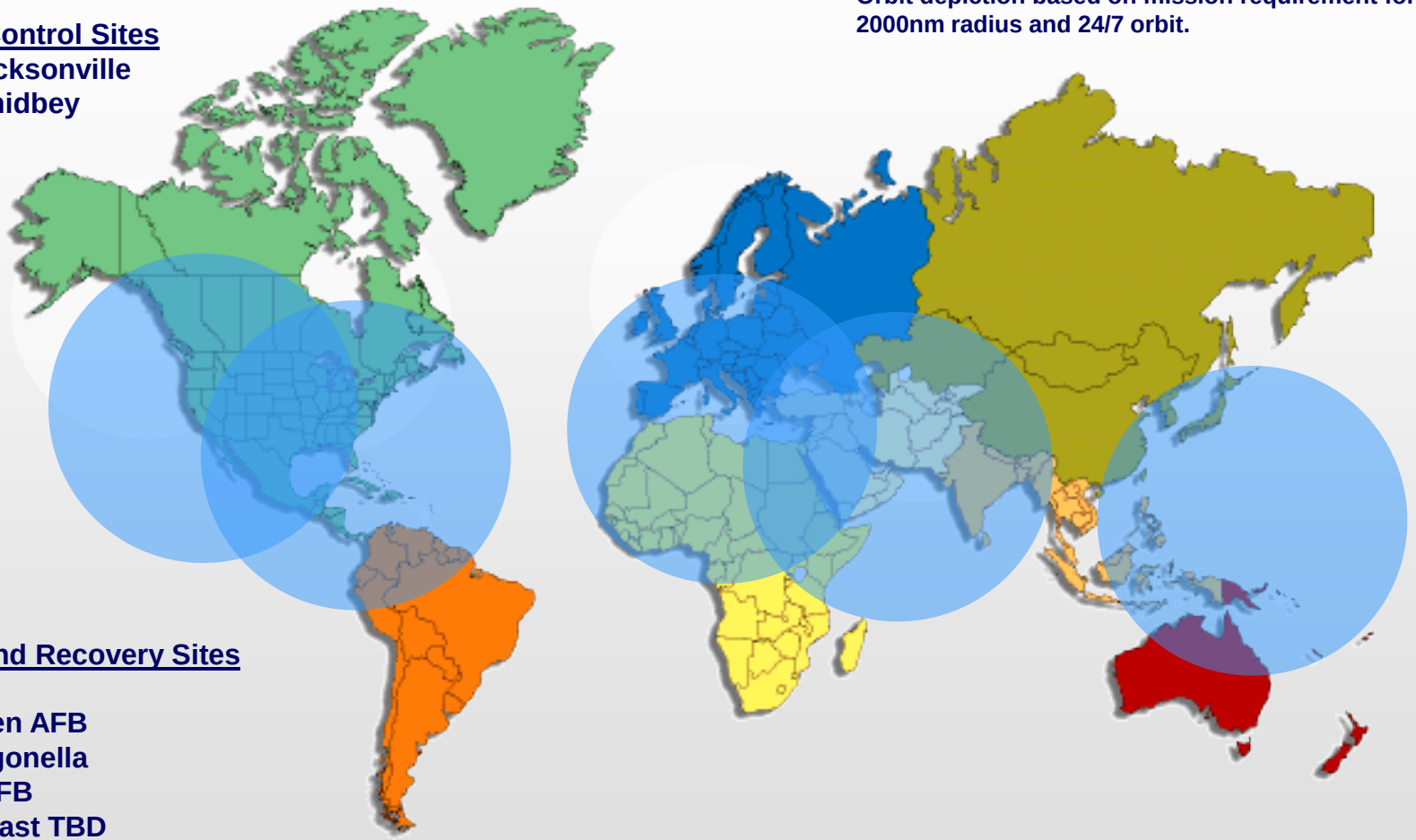


MOA signed between PMA-262 and 303d AESG and Endorsed by PEO (U&W) and USAF ASC Executive Director

Worldwide Presence

Orbit depiction based on mission requirement for 2000nm radius and 24/7 orbit.

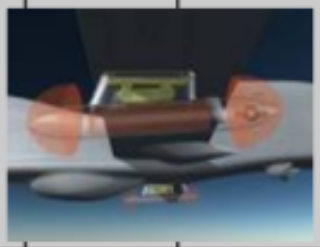
Mission Control Sites
- NAS Jacksonville
- NAS Whidbey



Launch and Recovery Sites
- C5F
- Andersen AFB
- NAS Sigonella
- Beale AFB
- East Coast TBD

JCIDS validated 5 orbit requirement for world-wide persistent ISR coverage

Future Capabilities

	FY-13	FY-14	FY-15	FY-16	FY-17	FY-18	FY-19	FY-20	FY-21
Baseline (Increment 1)	360° Maritime Sensors (Radar / ESM / EO-IR / AIS) Persistent ISR – 24/7 365 Min Mission Radius – 2000NM								
Airborne Comms Relay (Increment 2)		Robust Communications Relay Airborne / Battlegroup Networking Level of Interoperability (LOI) 4 Afloat JALN Maritime Domain Solution							
Signals Intelligence (Increment 3)			Robust Signals Intelligence Capability (POM-13)						
Future Capabilities	Room for Growth in Current Sensors MMTI / Weather Mode / IFF Interrogation in Radar Laser Designation / Range-finding (LDRF) in EO/IR								

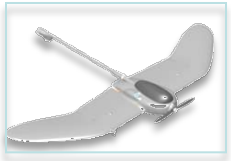
Summary

- **Adjunct to the P-8A to recapitalize P-3 mission requirements**
- **Provides military commanders with a persistent assessment of surface threats covering vast areas of open ocean and littoral regions**
- **Utilizing 360° coverage and advanced sensor, the MQ-4C will deliver unprecedented maritime situational awareness**
- **Continue successful execution of MQ-4C BAMS UAS SDD program**
  - First flight in summer 2012
  - Manage Systems Integration Lab and SDD vehicle builds to support first flight
- **Continued focus on common synergy opportunities**
  - Global Hawk and BAMS
  - BAMS and P-8A
- **Exploring international opportunities**

PMA-263
Small Tactical

PMA-263 PORTFOLIO

Wasp III



Wasp IV

RQ-11B Raven B

RQ-16B T-Hawk

Puma (AE)

GROUP 1

GROUP 2

GROUP 3

INTERNATIONAL

NAVY & MARINE CORPS PMA-263 SMALL TACTICAL UNMANNED AIRCRAFT SYSTEMS

ScanEagle

RQ-7B Shadow

ISR Services

RQ-21A Integrator

RQ-16B T-Hawk:
United Kingdom

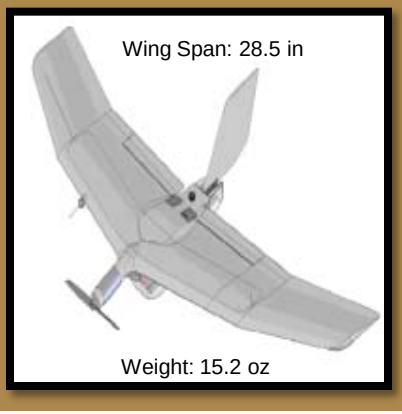
ScanEagle:
Columbia
Tunisia
Poland
Iraq

RQ-21A Integrator:
Netherlands

SMALL TACTICAL

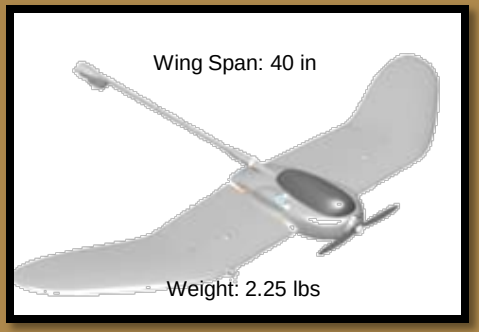
WASP MICRO UNMANNED AERIAL VEHICLE

- Greatly reduces the Intelligence, Surveillance, and Reconnaissance (ISR) request-to-response timeframe
- System provides the small unit with still images and live video
- Operational capability in the following areas:
  - Remote reconnaissance and surveillance
  - Force protection
  - Convoy security
  - Target acquisition
  - Battle damage assessment



WASP BLOCK IV

- Increase Reliability
  - All Environment
  - Robust design features
- Modular Payload
  - Increased gram capacity
  - EO/IR gimbal
- Precision Landing
  - Deep Stall Landing
  - Wide FOV landing camera
- Increased Maximum Performance
- Digital Data Link
  - Increased bit encryption
  - Dual band M1/M2



GROUP 1

SMALL TACTICAL

T-HAWK

- Provides a detection capability on a hover capable Unmanned Air System (UAS) to integrate into Explosive Ordnance Disposal (EOD) Training, Tactics, and Procedures (TTPs) for Counter Improvised Explosive Devise (C-IED) response.
  - Ability to gain situational awareness of incident site prior to arrival and throughout response
  - Ability to rapidly search area, regardless of terrain, with minimal personnel exposure, to identify suspect items and triggering mechanisms
  - Ability to coordinate, execute and refine neutralization TTPs

RQ-11B RAVEN B

- Small, reusable, back-packable, UAS used for 'over-the-hill' reconnaissance
- Hand launched and flies either under manual operator control or via a preprogrammed route
- Onboard sensors and communications equipment to gather and transmit imagery of the objective area back to the ground control station and remote video receive terminals
- Real-time images of the tactical environment to the company/detachment level out to a range of approximately 10km or line of sight.

GROUP 1

SMALL TACTICAL

PUMA AE (All Environment)

- Operational flexibility, endurance and a payload capability unmatched in its vehicle class
- Designed for land-based and maritime operations
- Hand-launched
- Capable of landing in salt water or on land
- Aerial observation at line-of-sight ranges up to 10 kilometers
- Gimbaled EO & IR payload
- Quiet to avoid detection
- No auxiliary equipment for launch or recovery
- Operates autonomously providing persistent ISR and targeting data

GROUP 1

CLOSE RANGE

SCANEAGLE

- Maritime and littoral requirement
- Provides organic, tactical level ISR capability
- Identification of commercial, military and other vessels ISO maritime domain awareness
- Surveillance of known smuggling and piracy areas
- Persistent to counter-insurgency of operations
- Route Survey Support
- Strike Support
- Battle Damage Assessment
- Pattern of Life

INTELLIGENCE, SURVEILLANCE, AND RECONNAISSANCE (ISR) SERVICES

- **Providing support CONUS and OCONUS**
- **Ship-Based support to the Navy and Marine Corps**
  - Installed / deployed on six types of ships to include LPD, LSD, HSV-X1, LHA, DDG, and T-AK 3017
  - Completed 21 ship deployments
- **Land-Based support to the Marine Corps, Navy, and Air Force**

GROUP 2

RQ-7B SHADOW

- Dedicated Reconnaissance, Surveillance and Target Acquisition (RSTA), Intelligence, Battle Damage Assessment (BDA) and Force Protection
- Four air vehicles (each configured with an EO/IR sensor payload), launcher, ground control station, attrition engine, and support equipment, including:

Re-Wing Configuration

- Increased wing span and higher Gross Take-off Weight
- Increased endurance (time on station)
- Increased capacity for payloads
- Future baseline configuration for all USMC RQ-7B Shadow UAS
  - Included as part of Tactical Common Data Link Upgrade
  - Stand alone upgrade as enabler for specialized payload Field User Evaluations
- Re-wing configured systems currently fielded in OEF

- Response to a Marine Corps approved Urgent Universal Need Statement; contract awarded Dec 2011 to AAI Unmanned Aircraft Systems to begin an effort to weaponize RQ-7B/Shadow
- The weaponization project is18 months, to be follow by a NAVAIR PEO(U&W) fielding decision

GROUP 3

RQ-21A INTEGRATOR

- Provide Marine Expeditionary Force (MEF) and subordinate commands a *dedicated* ISR system capable of delivering intelligence products *directly* to the *tactical commander* in real time

- Will support Navy missions to include:
  - Building the Recognized Maritime Picture
  - Maritime Security Operations
  - Maritime Interdiction Operations

- ***Expeditionary Employment*** that will support Navy & Marine Corps operations from air capable ships and shore/ground based locations

Early Operational Capability (EOC) System 1

- 1st flight, 2.47 hours, January 22 at the Marine Corps Air Ground Combat Center in Twenty-nine Palms, CA

- 10 hours of flight time in su
  Enhanced Mojave Viper Ex
  Generating Reliability and M
  data in support of EMD Effo

EOC System 2

- At Patuxent River for risk reduction component testing

- Transitioning to China Lake during summer

GROUP 3

ROAD AHEAD

- Rapid Technology / Payload Insertion – MULTI-INT
- Weaponization
- Reliability, Maintainability, Availability

Vertical Take-off and Landing Tactical Unmanned Air Vehicle (VTUAV)

VTUAV Current Activities
23 January 2012

Baseline Program

Support LCS Mission Packages in conjunction with the H-60

- The MQ-8B has flown over 1900 flights for over 4526 flights hours since 2006
- LCS-1 DI testing (13-23 Nov 2010); LCS-2 DI testing (3QFY12)

ISR Task Force Support

Afghanistan

- 3 A/C, 2 GCS, 300 hrs/mo FMV using GOCO contract
- First flight 2 May 2011
- 2027.9 flight hours to date

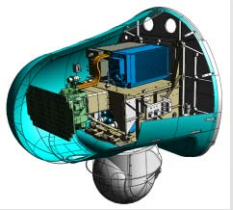
ISR Interim Support to SOF RDC

- JUONS approved as an Emergent Operational Requirement in August 2011
- Phased approach to provide interim support using MQ-8B and upgraded aircraft
- Deployments continue aboard USS SIMPSON and USS KLAKRING in 2QFY12 and 3QFY12

Weapons RDC

- Provides sea-based, weaponized VTUAV in support of UONS
- Incremental step towards POR weaponization

RADAR RDC

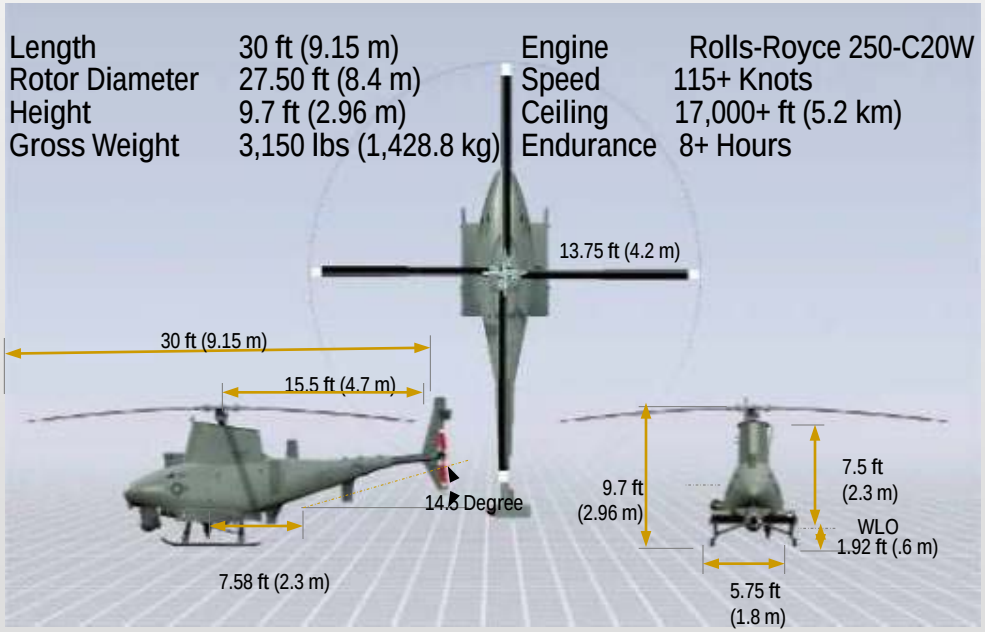


- Provides wide-area maritime search capability in support of UONS
- Incremental step towards POR RADAR

Navy Fire Scout VTUAV Program Description

- **Mission: The Fire Scout VTUAV system is designed to provide intelligence, surveillance, reconnaissance, and targeting data to tactical users**
- **Platforms: Designed to operate from all Air Capable Ships**
- **Description - A Fire Scout System consists of:**
  - **1-3 MQ-8B Fire Scout unmanned rotary wing air vehicles equipped with Brite Star II (EO/IR)**
  - **Ground Control Station (integrated in ship CIC) incorporating the Tactical Control System (TCS), utilizing Tactical Common DataLink (TCDL), Unmanned Common Automatic Recovery System (UCARS)**
- **Employment: The Fire Scout has been fielded on multiple FFG platforms and will soon deploy with the Littoral Combat Ships.**

Length	30 ft (9.15 m)	Engine	Rolls-Royce 250-C20W
Rotor Diameter	27.50 ft (8.4 m)	Speed	115+ Knots
Height	9.7 ft (2.96 m)	Ceiling	17,000+ ft (5.2 km)
Gross Weight	3,150 lbs (1,428.8 kg)	Endurance	8+ Hours



MQ-8 VTUAV
Component Descriptions

Fully Autonomous Aircraft

- Fully Digital, Dual Redundant Control System
- MQ-8B Based on Schweizer 333 Commercial Helicopter

Brite Star II EO/IR Laser Designation/ Range Finder Payload

- Collect imagery
- Relative range and LOS to target for precision target coordinates
- Laser designate target on command

Fully Encrypted, Digital Data Links; Land & Sea Ops

Tactical Control Data Link (TCDL)

UCARS-V2 for Ship Launch/Recovery

Harpoon and Grid Ship Deck Restraint

Interoperable Control Station with Tactical Control System (TCS) software integrated

- Open Architecture
- GCCS-M, JDISS, AFATDS, CCTV & JSIPS-N
- NATO STANAG 4586 Compliant
- Multi-Vehicle control

Ship Ground Control Segment (SGCS)

Total VTUAV System

100%

TCDL
- Wide band data link
- Component of LCS
- Added for other ship classes

100%

UCARS
- Guidance, Nav, & Control
- Precision Nav

75%

Support Segment
- Deck Handling
- Refuel/Defuel
- Non-powered A/C movement
- Landing Grid

100%

LSO
- Method to monitor and communicate w/aircraft
- Safety of Flight OPS

MQ-8B Schweizer 333

100%

Common Equipment
- ARC-210 Radios
- TCDL
- GPS/INS
- RADALT
- IFF
- Flight Power Conditioning Unit
- Aux Power Conditioning Unit
- Environmental Control System
- Ethernet Switch & Router
- Payload Interface Unit
- Ice Detector
- Vehicle Management Computers (2)
- Flight Control / Engine Actuators (6)
- Voice Digitizing Module
- Engine Interface Unit
- EO/IR Payload
- Ground control Panel
- I/O Data Panel
- Harpoon
- 3 UHF/VHF Antennas
- 1 UCARS Antenna
- 2 TCDL Antennas
- 2 GPS/INS Antennas
- 2 RADALT Antennas
- 2 IFF Antennas

Air Vehicle Software

97%

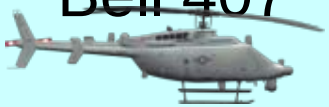
97% common software, 3% Vehicle Specific Module

100%

Ship Control Station

TCS

RDC Bell 407



Key
Existing
Modification
New

USS *Halyburton*

(Jan-Aug 2011)

- First fully-operational activity (Jan-Aug)
- Proven utility for maritime ISR Special Operations requirements
- Supported three counter-piracy actions
- Operation Unified Protector support to NATO
- Located stranded Yemeni ship that save 10 crewmen
- Manned and operated by embarked SH-60B detachment
- Rapid integration of SOF payload and vortex communications systems

DET A Accomplishments

- **Rapidly deployed three air vehicles, two ground control stations, twenty-eight personnel, and supporting facilities complex to Northern Afghanistan in two waves**
  - First wave departed 04APR2011, arrived 11APR2011
  - Second wave departed 15APR2011, arrived
- **Conducted first flight 02MAY2011**
- **Achieved IOC on 21MAY2011**
- **DET A has met or exceeded OEF mission requirements in support of RC North, in each month of operation since IOC declaration**
- **Integrated vortex comms systems in aircraft to provide dual broadcast capability to troops on the ground**
- **Installed hot weather modifications in three aircraft**
- **Provide counter IED, route clearance, over watch, and pattern of life intelligence**
- **Over 1,800 flight hours**

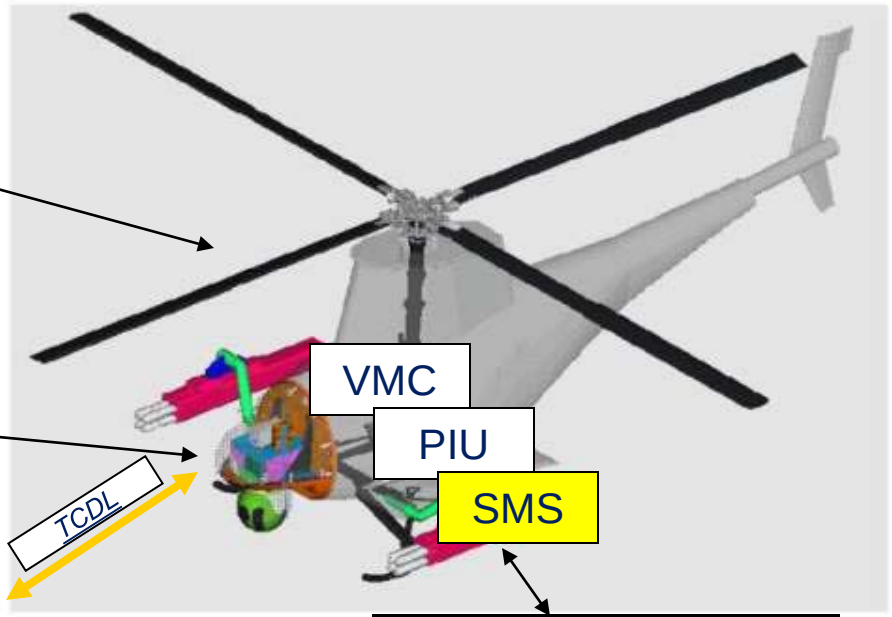
Fire Scout Weapon Integration

AIR VEHICLE

- Flying Qualities and Performance
- Safe Separation
- Loads / Noise & Vibration
- Flight Parameters
- Oblique Approaches
- Weight on Skid
- Lost Link Logic

Sensor/Targeting

- Auto Track
- Laser Designator Accuracy

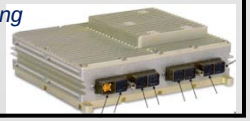


Ship Mods

- Storage
- Loading
- Handling

SMS/Launcher/Rack

- Master Arm
- Weapon Status
- Weapon Release/Firing
- Weapon Away
- Jettison



Weapon / Ship Qual

- HERO
- VIBE
- Shock
- Environment
- Buildup
- Cook-off
- Forward Firing Restriction

GCS

- Master Arm
- Trigger/Weapons Release
- Ready/Not Ready
- Weapon Status
- LAR
- Jettison
- Mission Planning

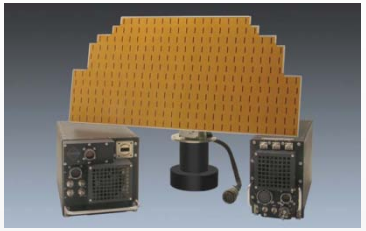
FAILURE MODES

- Lost Link
- Hard Landing
- Hang Fire
- Hung Store

Weapon

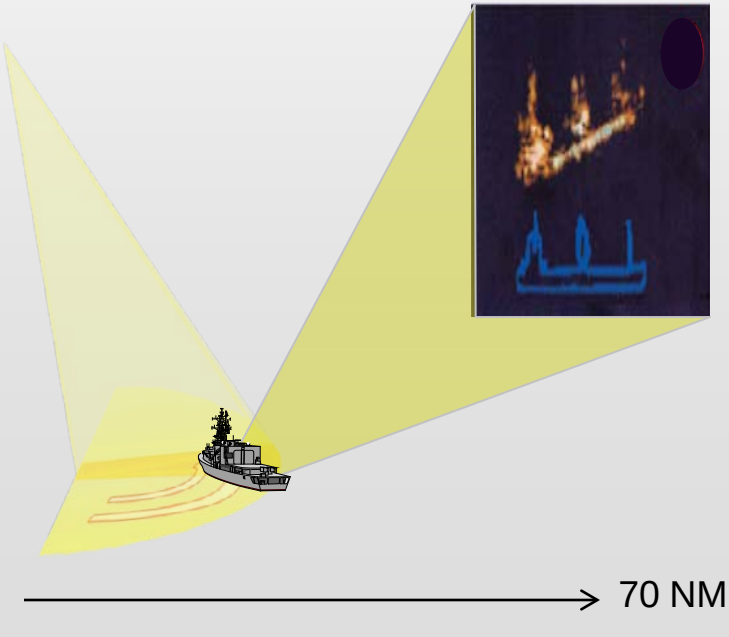
APKWS

Maritime Radar



- **Maritime Radar will provide the following capabilities**
  - Search, detection, surveillance, and tracking of maritime surface vessels
  - Inverse Synthetic Aperture Radar (ISAR) imaging for surface vessels
    - Provides initial classification of targets well beyond EO/IR sensor ranges
  - Interface with the Fire Scout Modular Payload Architecture (MPA) via its Payload Interface Unit (PIU) for control data and downlink of radar output data

- **IOC: FY13**



Support to SOF JUONS Requirement

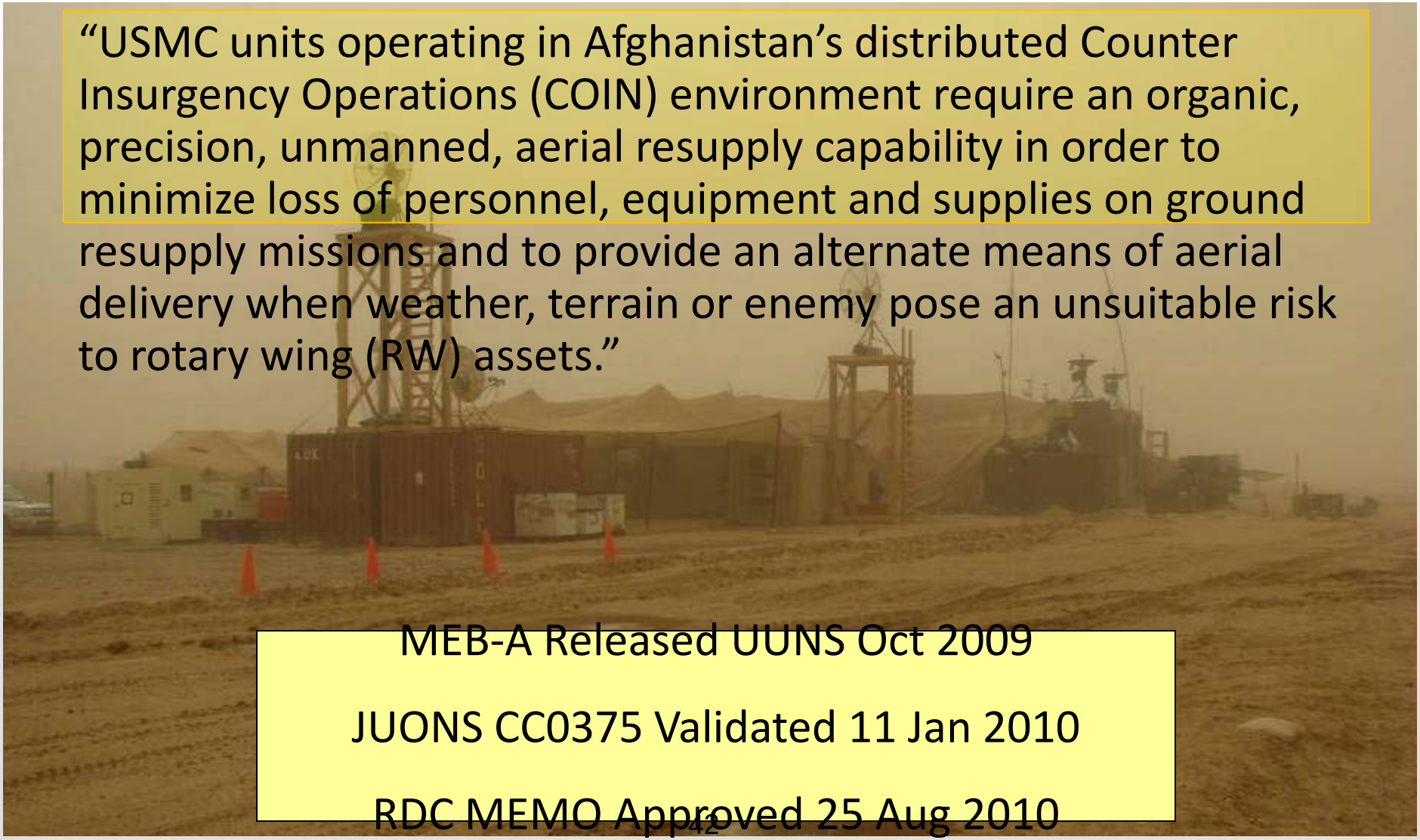
- **A Sea-based, airborne ISR platform supporting Counterterrorist/High Value Individual operations in the Arabian Peninsula/East Africa area**
  - Desire for three “orbits” (24 hour coverage of three targets)
- **Operating range of 150 nm (threshold) from the host platform**
- **Endurance of 8 hours time on station (threshold)**
- **Must carry multiple payloads to include full motion video and other specialty payloads (threshold)**

Cargo UAS Program Overview

Firm Fixed Price Services Contract

- **PoP based on the RDC (270 days) 3 Dec 10 through 28 Aug 11**
  - Includes all activity through QRA
- **Deployment CLIN**
  - 6 month deployment with monthly options (up to 6 months, totaling 12 month)
- **Government Owned Contractor Operated (GOCO)**
  - Hardware
    - Government : Aircraft and FOB GCS
    - Contractor : MOB GCS
  - Operation:
    - Government: Mission Commander, FOB Operators, HST
    - Contractor: Mission planning, aircraft control and operation, aircraft/MOB GCS maintenance

Joint Urgent Operational Need



"USMC units operating in Afghanistan's distributed Counter Insurgency Operations (COIN) environment require an organic, precision, unmanned, aerial resupply capability in order to minimize loss of personnel, equipment and supplies on ground resupply missions and to provide an alternate means of aerial delivery when weather, terrain or enemy pose an unsuitable risk to rotary wing (RW) assets."

MEB-A Released UUNS Oct 2009

JUONS CC0375 Validated 11 Jan 2010

RDC MEMO Approved 25 Aug 2010

Navy Unmanned Combat Air System

UCAS-D Update

CAPT Jaime Engdahl
PMA-268 Navy UCAS
Program Manager

Presented to:
The Technical Cooperation Program
26 March 2012

PEO U&W

X-47B UCAS Demonstration

- Tailless, autonomous unmanned system under development by the U.S. Navy and Northrop Grumman
- Will be used to demonstrate first carrier-based launches, recoveries of an autonomous, LO-relevant aircraft
- Will be used to mature relevant carrier landing and integration technologies, and demonstrate autonomous aerial refueling

UCAS-D Program Overview

Government Controls Interface

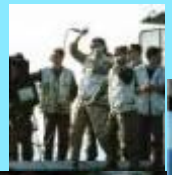
Air Vehicle Segment

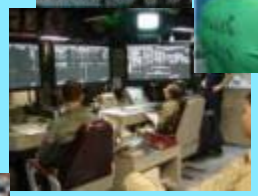
AAR Segment

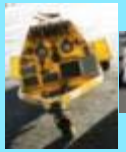
Support Segment

Includes Deck Handling, Maintenance and Unique Support Equipment

CV Segment





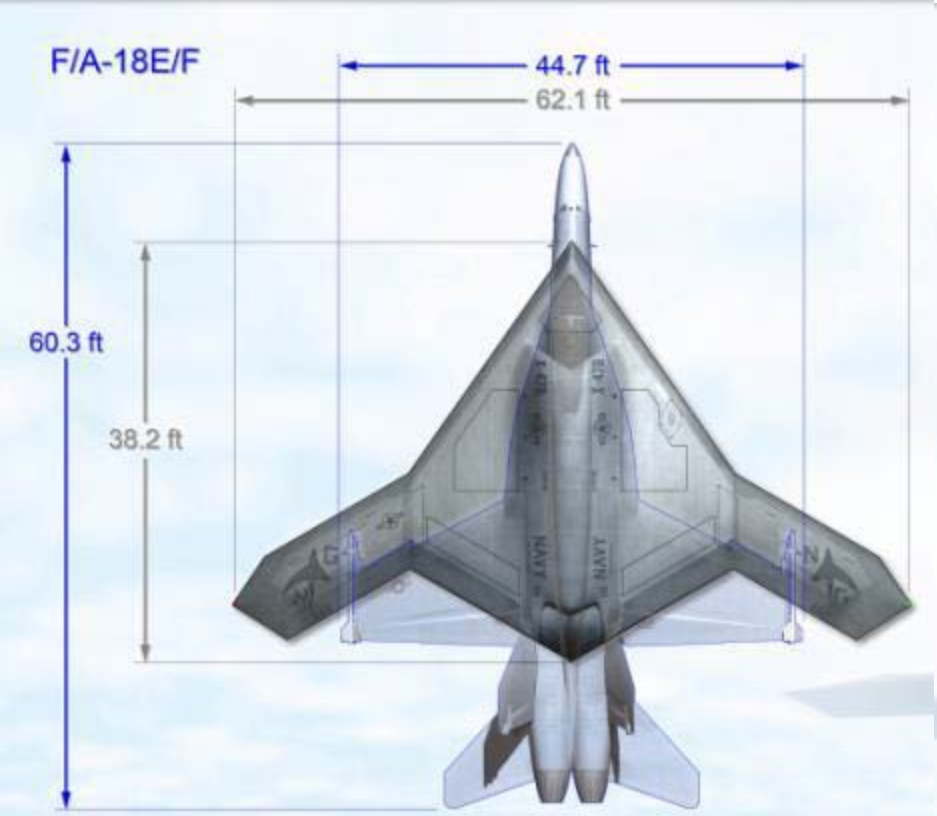


Includes Shore Based and Shipboard Facilities, Work Centers, Shipboard Equipment and Common Support Equipment

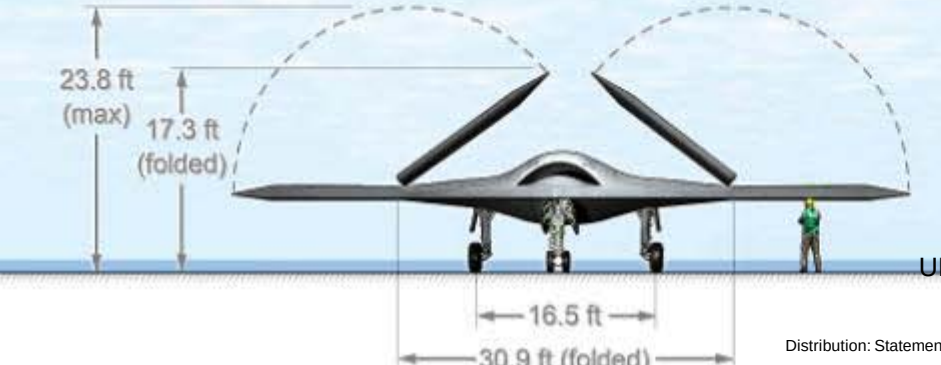
Mission Control Segment

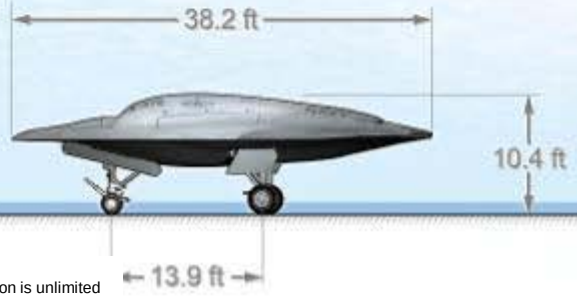
Including Mission Planning, Mission Control and Related Functions

UCAS-D Air Vehicle System (X-47B) in Focus



Design	*Tailless, cranked-kite*
Planform	*LO relevant features*
Structure	*Carrier approved*
Take-off gross weight (demo)	*44,000 lbs*
Engine	*PW F100-PW-220U*
Twin Internal Weapons Bays	*4,500 lbs payload*
Aerial refueling provisions	*USN / USAF style*
CV launch OPWOD	*+2.2 knots*
CV recovery WOD	*+7.2 knots*
Spot factor (F/A-18C)	*0.87*





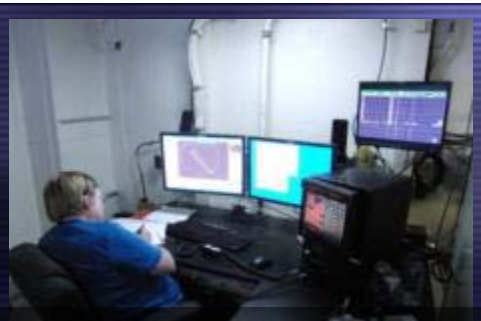
X-47B Flight Test Activity

Modeling and simulation predictions proving to be highly accurate when compared to flight test data

- **16 Envelope Expansion Flights completed Feb – Nov 2011**
  - Cleared envelope to 15,000 ft MSL altitude, 200 knots
  - X-47B system checkout
  - Validated:
    - Air vehicle aerodynamic performance;
    - guidance, navigation & control models; mission planning and command/control functionality
  - Operations in all modes: ground, takeoff, cruise, approach
  - Validate X-47B PGPS/TTNT landing system functionality

NAVAIR Public Release 11-1193
Distribution: Statement A – Approved for public release; distribution is unlimited

UCAS-D Aircraft Carrier Command and Control


Mission Operator Station


CATCC


Tower (“Pri Fly”)


LSO Station

UCAS-D Manned Surrogate Test Activity

- Autonomous Arrested Landing with a F/A-18D Manned Surrogate 2 July 2011

- An interim step to demonstrate landing technology and unmanned autonomous operations with the safety/redundancy of a man in the cockpit

- USS Eisenhower testing:
  - 36 approaches
  - 16 touch and go landings
  - 6 coupled approaches to arrested landings

Successful Testing Reduces Risks, Builds Confidence for X-47B Carrier Landings in 2013

UCAS-D Support Segment


Safely Positioning the Aircraft on Deck

Non-Powered Aircraft Movement


Fueling/Defueling


Maintenance

Upcoming UCAS-D Activities

- Air Vehicle 2 relocation to NAS Patuxent River, Md.
- Shore carrier suitability testing (2012)
- X-47B carrier landings (2013)
- Autonomous Aerial Refueling (2014)

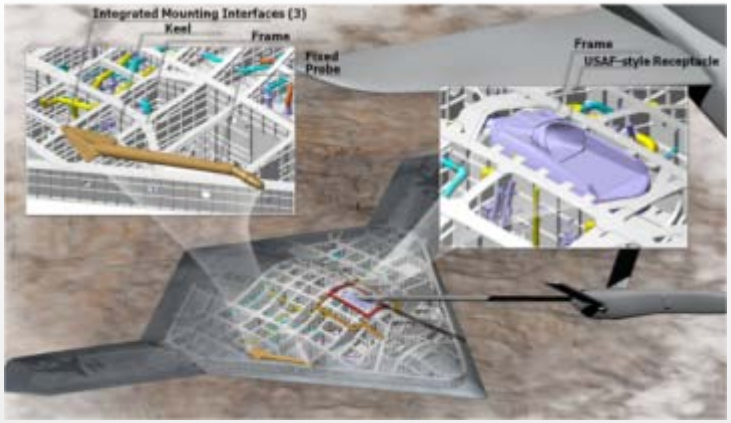
Navy UCAS Seamless Integration

- X-47B Airworthiness
- Certification of Installed Carrier Systems
- Certification of PGPS Navigation performance

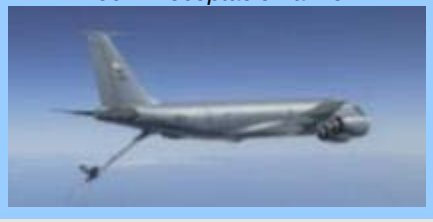
Autonomous Aerial Refueling (AAR)

Complete Demonstration of USN (Probe-Drogue) and USAF (Boom-Receptacle) AAR methods by FY14

- Transfer 3000 lb to X-47B via each method



Boom-Receptacle Tanker



Probe-Drogue Tanker

QUESTIONS ?